

terface (ODI) client, multiple protocols soon will be able to run simultaneously over a PPP link, such as IPX and LWP IP. This represents major new functionality. When you dial in, you should be able to run as many network protocols as you need, simultaneously if necessary. Servers just need to start routing more protocols to support dial-ins from NetWare IPX, LAN Manager, Windows for Workgroups, NetBEUI, VINES IP and, of course, TCP/IP and AppleTalk.

This works because the PPP architecture handles support for multiple network protocols. For each network protocol, a PPP data link driver needs a corresponding Network Control Program (NCP) implementation. AppleTalk already has an IETF-standard NCP called ATCP (RFC 1378). A similar standard NCP has been defined for TCP/IP (IPCP, RFC #1332). Standards for PC-oriented protocols are also defined or in the works.

Unfortunately, Apple didn't announce any specific product plans or delivery dates.

With this announcement, we assume Apple and Shiva plan to offer a

PPP data link driver and the ATCP NCP protocol adapter for the Macintosh client. We also figure the new ARA will work as easily and transparently as the current implementation. We hope it does not require a set of modem scripts in addition to the current ARA and Macintosh Communications Toolbox implementations. We also hope they'll include an IPCP implementation for the Macintosh that will allow Apple's own MacTCP to run over PPP. Third-party solutions are already available that let MacTCP use PPP—for example, the public-domain MacPPP utility—but these don't have anything to do with getting AppleTalk to run over PPP. We'd also like Novell to supply an IPXCP for its new MacIPX stack. Apple's Open Systems Interconnection (OSI) products certainly could use a remote access solution as well.

On the server side, with the promise of Mac ARA PPP clients dialing in, server products will have to support ATCP NCP and route or bridge AppleTalk too. If we have Macintosh software that supports PPP dialing, we need servers that can an-

swer the phone, speak PPP and then run AppleTalk over that pipe. The companies did not say whether Apple will start providing multiport ARA PPP servers, but partner Shiva certainly will.

Apple's finally setting its sights on the enterprise networking target for remote access solutions. This will serve to motivate the many vendors struggling to get their PPP server solutions working—all those Powerbooks out there need to call home every once in a while.

## The Internet Goes to the Head of the Class

by Linda Nicastro

Fifth- through eighth-graders from schools in the United States and England recently held an Internet-based videoconference to sum up their collaborative on-line study of the environment. It looks to us like the kind of project for which we should use the emerging National Information Infrastructure (NII).

During a six-week curriculum, the students read Vice President Al Gore's book, *Earth in the Balance*, and studied groundwater pollution and its source in their communities. The groups, at schools in Arlington, Va.; Knoxville, Tenn.; Oceanside, Calif.; and several English schools coordinated from Hampton, England, did traditional library research and took outdoor field trips to gather water samples and record videos. In addition to videoconferencing, the students used the Internet to investigate databases and exchange research findings via electronic mail.

The highlight of the project was the videoconference, however, when the students compared their research and videos on groundwater pollution and had a chance to ask questions of officials in attendance, including representatives from the White House Office of Science and Technology Policy, the directors of the National

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Science Foundation (NSF) and a NASA scientist. Carl Malamud, principal of the Internet Multicasting Service and founder of Internet Talk Radio, served as project coordinator and conference moderator.

The project was the first activity of the Global Schoolhouse, an ongoing collaborative learning venture supported by the NSF and 30 other organizations that have made long-term loans and donations of equipment and services. Organizers hope future Global Schoolhouse activities, such as teacher training and an online science fair, will involve children from additional schools and countries. Projects like the Global Schoolhouse are important because they "put the technology into the hands of the people you need to empower... the teacher in the classroom," says Don Mitchell, an NSF staff associate.

A combination of T1 and Switched Multimegabit Data Service (SMDS) lines were put in place by Sprint, Bell Atlantic, Southern Bell and Pacific Bell. Routers from Cisco Systems linked the schools' local networks to the Internet. Sun Microsystems SPARCstations served as reflectors, taking video images from one site and sending them to other sites. Macintosh Quadra 700 computers provided

by Apple Computer were equipped with TeleCamera video cameras from Howard Enterprises and ran Cornell University's CU-SeeMe videoconferencing software. Audio was carried separately through high-end speaker telephones provided by J. Howard Associates.

With Internet connections in place and Macintosh computers equipped with MacTCP, Quicktime, video cameras and video boards, the schools were able to use the CU-SeeMe software. CU-SeeMe enabled the students to receive small, black-and-white video images of each site in windows on their Macintosh screens. Cornell's software, still under development, is available publicly at no cost.

"The technology is rather crude by TV standards. It gets close to TV quality at good times, but with a bunch of feeds and activities on the screen, the frame rate drops. But nobody cared. They were so pleased

with it," says NSF program officer David Staudt.

"This will take off on its own merits and be accepted in the education community," he adds.

The water pollution study project was put together in 10 weeks, including donation, distribution and linking of the technology to make the videoconference possible. The project therefore stands as a good example of how government, industry and education can cooperate. We hope to see more of this sort of collaboration in the future.

Contact the NSF to learn more about the Global School Project or to donate time, equipment and services: National Science Foundation, Division of Networking and Communications Research and Infrastructure, 1800 G St. NW, Washington, D.C. 20550; (202) 357-9717, fax (202) 357-5865, Internet: gsh-info@internic.net. ■



## Students Rave About Internet Experience

**W**e asked students who participated in the Global Schoolhouse project to evaluate it. Here are excerpts from their e-mail responses:

"I found it really exciting to participate in the Global Schoolhouse project because talking to people on the other side of the world about problems that affect us all is really cool. The problems of river pollution are serious. The more we can compare results and experiences and put that information into use, the better it will be for our rivers."

—Sarah Robb, age 13, grade 8, Orleans Park Secondary School, London, England

"I enjoyed working on the Global Schoolhouse project because I got to learn more about computers. I also had the

chance to meet people from all around the world. If I had the chance to do this again, I would love to!"

—Alexi Charles, age 10, grade 5, Long Branch Elementary School, Arlington, Va.

"This has been a very good learning experience. I have learned what exactly is happening to our environment and what I can do to help. If this becomes available to all schools, we will have a very powerful tool to combat environmental problems. I hope all students will be able to have the learning experience that I did."

—Jeromy Henry, age 13, grade 7, Jefferson Junior High School, Oceanside, Calif.

—L.N.